Ground-based pest control in kea habitat

A safe practice guide

Kea Conservation Trust

Best Practice Standard 1.1 (2022)

Contents

Cover photograph: [Female kea caught in a leg hold trap on the West Coast © Mark Martini]

1.0 Purpose

This document is intended as a guide to best practice for deciding on ground-based pest control activities conducted in known kea habitat or on its boundary. The purpose of this document is to reduce the risk of injury or death of kea (*Nestor notabilis*) when targeting small mammals such as possum, rats, feral cats and mustelids through the use of trapping (either live capture or kill traps) or toxic bait (hand-laid using various methods). This document will identify which pest control devices are known to be safe for use in kea habitat or can be made safe with simple modifications to set methodology, seasonal timing, or trap architecture (e.g., the addition of guards to restrict access to kill mechanisms). Traps that are unsuitable and should not be used near kea are identified with justification from field-observed fatalities or through testing in aviary settings by qualified researchers.

This document is in line with Focus Area 2 of Orr-Walker et al. (2019; section 5.2) "All About Kea–a framework to focus kea conservation initiatives", which states a requirement to identify and quantify threats and their management. One of the nine threats to the wild kea population Orr-Walker et al. (2019) identifies is accidental death through pest control practices. Kea Conservation Trust aims to work closely with New Zealand trap manufacturers to ensure devices address kea non-target risks before they are commercialised into the market.

Through better education of safe trap use, it is hoped that land managers, stakeholders and the public will be able to navigate the suite of traps and toxins currently available and make sound decisions on which is most appropriate for their pest control operations. Within this document, traps and toxins are described in their relation to the target pest species so that alternatives to unsuitable traps are easily identified. In order to assist this selection process, three decision-making tables have been developed and will be updated as new information/technology comes to light.

2.0 Background

2.1 Introduced predatory mammals

Since human occupation, Aotearoa's biodiversity has been impacted by the inadvertent and deliberate introduction of predatory mammals. These vertebrates have brought huge devastation to native flora and fauna, which are vulnerable and defenceless to introduced pests, having evolved in a landscape free from predatory mammals. In the following decades, these source populations were able to proliferate and hugely impact terrestrial ecosystems across the whole of Aotearoa.

The challenge of protecting biodiversity from introduced predators has resulted in the design and implementation of various novel predator control methods. 'Classic' northern hemisphere leghold and kill traps were coupled with the invention of new novel devices for controlling rodents, mustelids, feral cats, possums and hedgehogs. Only in recent decades has the need to ensure the safety of non-target native fauna, such as kea, been a paramount concern when landowners, managers and general public engage in targeted pest control.

Target and non-target animal size, shape and behaviour are key components that help maintain the species specificity of traps through the process of design and application. The advent of digital devices capable of selecting operation timeframes and excluding certain weight thresholds have advanced the capabilities of pest control specialists to keep native fauna safe. It is now our responsibility to only use suitable “proven safe” devices in habitat known to contain vulnerable non-target native fauna such as kiwi, kea and weka. This document helps to guide the end users towards traps that are ideal and safe either as off-the-shelf units or through modification of device architecture (e.g. shrouds), or use parameters like seasonality and specific placement. All operators are strongly encouraged to report any findings in relation to identified safety risks of these devices to kea and to report incidences of injury or death with the knowledge that such reporting will lead to a safer pest control industry.

2.2 Kea

Kea are renowned as one of the world’s most intelligent birds, being part of a select group of animal tool-users. Kea provide essential ecosystem services, and as the only mountain parrot in the world, bring colour and character to Aotearoa’s southern landscapes. However, for all of its unique qualities, the future of kea remains uncertain. New Zealand’s unique, endemic parrot is disappearing from the mountains of Te Waipounamu (South Island), due to a range of threats, past and present. Habitat loss, predator populations and human-influenced environmental risks (such as lead) continue to be agents of decline for globally significant iconic parrot.

Photo 1: Juvenile Kea on exposed scree slope (Brent Barrett)

Kea frequently forage on the ground and are also obligate ground nesters. As such, they are vulnerable to predation by introduced predators, particularly stoats and possums. Female kea are particularly vulnerable during their long three-month nesting period which can occur

between July to February each year. Results of research on kea productivity shows critically low nesting success (c.5%) during stoat plague years (following beech and/or rimu mast events) in areas without pest control, versus high nesting success (c.75%) in areas with effective kea appropriate pest control (Kemp et al, 2182). As ground feeders, the adults of both sexes may be ambushed by stoats and feral cats while foraging (Kemp et al, 2022). Predator control increases the chance of adult survival and therefore improve population dynamics and resilience in occupied habitat. However, juvenile birds disburse from natal sites and flock up in alpine areas which may not have any pest control activities. Being young and behaviourally naïve, they are vulnerable to life threatening events such as predation, accidental drowning, or consuming toxic material like lead, rubber, or poisons.

Photo 2: Kea prostpecting nest (A) also being visited by stoat (B), Rowi kiwi (C) and possum (D) (Brent Barrett/DOC)

Predation by introduced predators such as rats, stoats and possums, has historically been considered a lesser issue to kea than many other New Zealand endemics (Elliott and Kemp, 2004). However, due to kea ground nesting, they are potentially as vulnerable to predation as their close relative the kaka, although nesting success has previously been found to significantly increase above 600 meters (Elliott and Kemp, 1999). In lowland forest, kea also face competition for burrow space or possible disturbance by kiwi (Photo 2). There is recent evidence of predators moving higher into alpine areas, possibly due to changing climatic conditions, therefore the threat to nesting success may be increasing. Possum remains and fresh scat have been found in or around kea nest sites over 1000m (KCT, unpublished report 2009). Possums may not only directly predate on nesting kea and/or their chicks, but they may also compete for available nest sites and natural food sources.

3.0 Scope

This safe practice guide outlines all traps and toxins currently available in New Zealand in accordance with the target species they are suited to. These traps will be categorised by the target species, trap type (i.e. deployment method), suitability in kea habitat and possible mitigations to alleviate risk to kea. Where necessary, and based on recorded field data, high-risk traps will be clearly identified as unsuitable for use in any kea occupied land. This document will include a section with decision-making tables to easily present alternatives to these unsuitable devices. The main focus of this document is to outline trap/bait types and setting methods which minimise kea interference and consequently alleviate health or mortality risk to kea. It also provides a means to report kea injuries or deaths caused by pest control devices to enable on-going knowledge building and provides information on pest control suppliers and contractors.

Vertebrate toxic agents (VTA) are common practice in pest control activities with many having their use closely regulated by the Environmental Protection Agency (EPA) and the Controlled Substance Licence scheme (CSL). The main VTAs used for pest animal control will be discussed in terms of poisoning risk to kea (such as through secondary poisoning and direct ingestion from bait station/bucket use). Bait deployment mitigation options will be highlighted, along with any toxins that should not be used in any kea occupied habitat.

New pest control devices are being commercialised each year. Consequently, this document will be frequently updated and remain a living document. The list of current pest control devices available is complete at time of production of this document. See best practice standard version number and year of update on front page.

The scope of this document does not include research into kea safe pest control methodology or exposure trials with captive kea, however this essential work will be carried out as part of the Strategic Plan for Kea Conservation, the results of which will be added to this document.

Any use of traps or toxins on Public Conservation Land requires permission from the Department of Conservation. DOC only allows the use of tools that have been through an assessment by a technical panel, and risks associated with those traps and toxin uses that are accepted for use are managed through performance standards. These standards should be seen as the minimum requirements and for some tools Kea Conservation Trust advice in this document promotes a more cautious approach.

4.0 Kea behaviour and habitat

There are no clear risk factors or mitigation measures that can be identified to reduce the risk to kea from devices that have been categorised as ‘unsafe’. Kea are vulnerable year-round and from sea-level to the alpine zone.

For a pest control tool to be used in kea habitat, it needs to either:

1. be kea-safe (kea are effectively excluded), or

2. demonstrably deliver more benefit than cost to the kea population (given the mobility of kea this needs to be achieved at a landscape scale, which is difficult if using ground-based methods in isolation), or
3. be categorically required for the benefit of another highly endangered species

4.1 Morphometrics

To ensure that traps are made safe for use around kea, it is important to know the various morphometric parameters of kea such as weight and size. Adult kea weights and measurements vary significantly between individuals with the highest diversity in beak length. However, as a rule, males are generally larger and heavier than females (Fijn, 2003). A combination of weight, skull and beak measurements can be used to identify probable thresholds that exclude kea, while still targeting larger animals (such as feral cats or possums) and smaller mammals (such as rodents, hedgehogs, stoats and weasels). Summaries of these dimensions are in Table 1 below:

Gender	*Weight range	Body length	Beak length	Skull length
Males	850 -1000g (average 930g)	46cm	>45mm	>65mm
Females	750-950g (average 840g)	46cm	<45mm	<65mm

Table 1: Average adult kea weights and measurements (Elliott & Kemp, 1999; Kemp pers. comm. 2009)

** Westland lowland kea weights are significantly lower with males averaging 850g (Barrett, pers comm., 2010)*

4.2 Feeding behaviour

Kea are opportunistic omnivores and consume a wide variety of foods in the wild. Behavioural, faecal, and gut studies have shown that kea eat over 200 varieties of natural foods including a wide range of animal and vegetable matter. Foods include grasshoppers, beetles (adults and larvae), ant larvae, weta and cicada nymphs, other invertebrates and the roots, bulbs, leaves, flowers, shoots, seeds, nectar and fruit of over 200 native plant species (Brejaart, 1988; Clarke, 1970).

Kea have also been recorded eating other bird and mammal species including: Hutton's shearwater (chicks and eggs), racing pigeon, morepork/ruru, sheep meat and bone marrow, and stoat and possum carcasses (Brejaart, 1988; Barrett pers. comm. 2010). Kea often go to great lengths to dig shearwater chicks and eggs out of burrows. The scarcity of food in the alpine environment is a main driver for kea persistence in food gathering a behaviour which translates to sustained attempt to access pest control traps. A feature of high intelligence is a prolonged "childhood" of learning behaviour from parents; unfortunately, this also results in the transfer of problematic behaviour, such as gaining access to and setting off DOC200 traps.

Kea have also been known to consume fat from the carcasses of hunted introduced mammal species such as tahr, deer and chamois (Maloney, pers. comm.), and on occasion are also known to attack the fatty area around the kidneys of live sheep left high in the alpine areas (i.e., above 600m) during winter when resources are low (NHNZ, 2006).

Kea are one of the few species which have managed to take advantage of humans moving in to their habitat. They use their beak, cognitive abilities, and tenacity to access resources and investigate any potential uses of new objects. Rubbish dumps and bins, seasonal deer culls, farms and ski fields continue to provide useful sources of food (and toxins in some cases) for kea in times of hardship.

Historical burn-off of high-country forests by farmers and continued legal annual burn-off of these areas between June and October (ECAN, 2005) have significantly decreased the availability of natural food sources throughout the natural range of kea. How this impacts the survival of the species is unknown. However, research into the major cause of death in kea has historically been attributed to lack of food resources (Jackson, 1969).

Photo 3: Kea have very good beak dexterity (Andrew Walmsley)

Wild kea spend over half of their day inactive (over 54%) with the remainder spread fairly evenly between foraging, moving/flying and body maintenance activities (Brejaart, 1988). Figure 1 below shows the breakdown in activity of an average wild male kea.

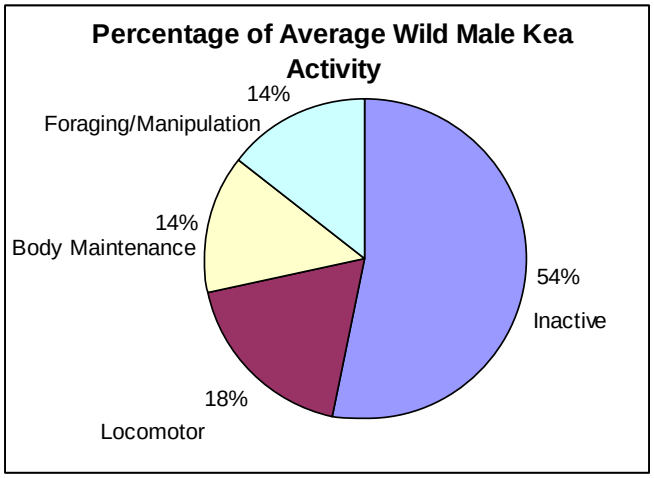

Figure 1: Breakdown of male kea activity.

5.0 Kea habitat

Kea are now restricted to the South Island of Aotearoa. A significant decline in kea distribution from the 1980s has been identified in the northwest area of the South Island (Robertson *et al.*, 2007). The New Zealand Bird Atlas indicates that the kea population is sparsely distributed across its range of approximately 3.5 million hectares from Waitutu in the far south, to Kahurangi in the northwest (Figure 2). Although closely associated with the spine of the Southern Alps, kea are far ranging, and are present down to sea level on the southern, western and northern coasts of the South Island, extending across the alpine tops of the main divide through to the eastern foothills of the Alps. Their most eastern range is the Kaikoura Mountains. Kea utilise pine forests and farmland adjacent to forested areas as well as indigenous habitats, including forest, scrub, alpine herb fields, wetlands and braided riverbeds. The only areas in the South Island where kea are unlikely to be found are on eastern lowland grasslands which are isolated from forested areas and in remnant forests from which kea have been extinct for decades, such as the Catlins and Marlborough Sounds.

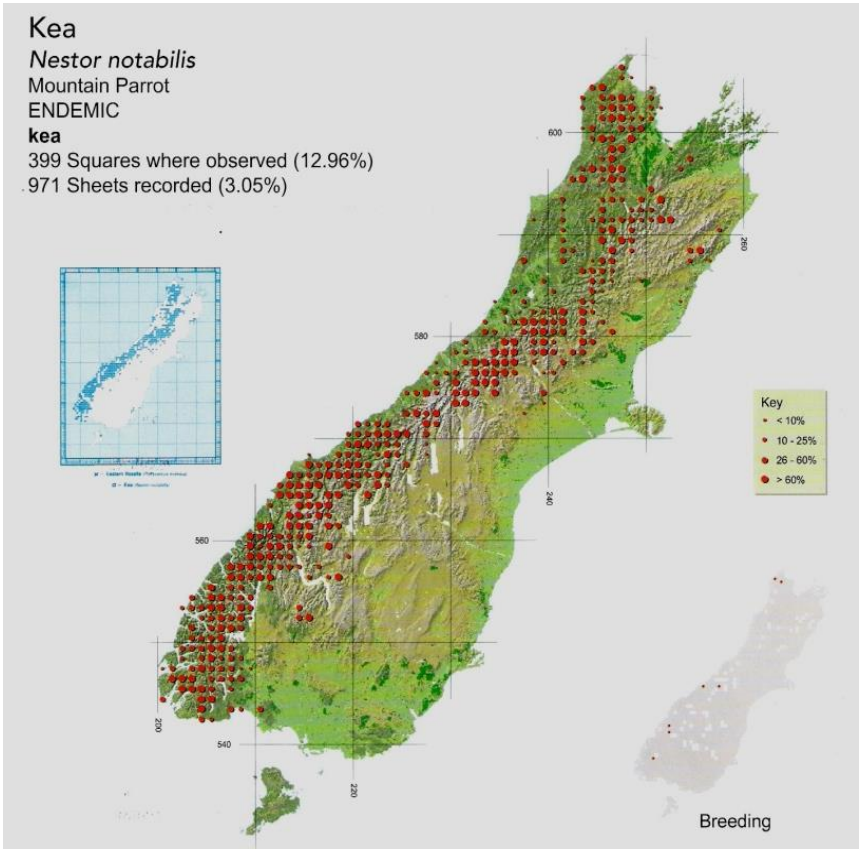

Figure 2: Present distribution of kea in the South Island of New Zealand (Robertson et al, 2007).

Territories are extensive and can cover up to 4km² (Jackson, 1969; Elliott & Kemp, 1999). Breeding pairs may have one or more nest cavities positioned on a spur and their territory will extend from the forest floor up to the alpine area above tree line (Kemp pers. comm., 2009). There has never been evidence of more than one breeding pair occupying the same spur (ibid).

6.0 Pest control methods in kea habitat

This section details which pest control devices impact on kea, why kea are vulnerable to them, and how to minimise kea interference.

General rules to decrease kea interest/interference include:

- **Reduce visual attractiveness**. Shiny, white or bright coloured objects are more interesting to kea. Painting pest control devices a dark colour will reduce their attractiveness.

- **Utilise seasonal movements or changes in behaviour.** Are kea only present in your operational area for part of the year? Can the operation still meet its targets if tools that would present risk to kea are only used when they are absent?

- **Novelty value**. Do not arm traps or fill bait stations for at least 1 - 2 weeks when they are first set up – kea are attracted to and are most likely to interact with novel objects. Assume that kea have noticed new traps being set and allow them the time to check them out safely. Assuming they receive no reward (i.e. a food lure or something they can manipulate), they will get bored and be more inclined to leave them alone.

- **Do not use lures which provide a reward**. Once kea find a benefit to access a trap or bait station, they are likely to revisit even if a reward is then removed. For instance, researchers have found that even a visual lure which is easily manipulated (such as white corflute used to attract possums), will encourage kea to revisit whereas a visual lure which is not able to be removed or damaged (such as white powder coated aluminium), very quickly becomes disinteresting to kea. Food lures are the ultimate reward and should not be used where access by kea can't be completely prevented. Remove and pack out old lures and bait when replacing them, rather than disposing of them on site, to reduce the opportunity for kea to discover novel food.

- **Monitor condition, maintain and replace when necessary**. While a well-designed trap set or bait station will limit kea access, damage accumulating over time may reduce the effectiveness. Treat every trap or bait station service as an opportunity to check the device, and be prepared to repair, replace or close down devices if they are losing their integrity.

6.1 Decision-making table

The following tables outline pest control methods, their risk profile, and risk mitigations. These three tables address the main elements of ground-based pest control (excluding firearms):

- **Traps** – designed to capture animals alive or to ethically kill target pest animal. Their suitability for use in New Zealand is indicated by passing NAWAC testing (see below). Only NAWAC approved devices are considered below, and all other devices should not be used in kea habitat until they have passed NAWAC and proven to be ethical.

- **Toxins** – Vertebrate toxic agents that are regulated by the Environmental Protection Agency and the Ministry of Primary Industries (MPI). The use of some devices requires the user to hold a current Control Substance Licence while others are available off the shelf. All toxins should be handled and used with extreme caution and instructions on the label must be followed.

- **Bait delivery systems** – these are used to increase the longevity of bait availability and to reduce or control non-target access. Regardless of design, any such system which can be lifted or removed will not be suitable for use in kea habitat because it increases the risk of toxin entering water ways or kea accessing toxin through determination.

A kill-trap, by definition, must kill the target animal and do so quickly and consistently. Traps that have passed testing under the guidelines laid out by the National Animal Welfare Advisory Committee (NAWAC) are considered to be humane for that species. An up-to-date table of traps that have been tested under NAWAC guidelines and either passed or failed can be found on the Bionet website (https://www.bionet.nz/rules/performance-traps/).

Some traps are considered 'Data Poor' either because they have recently come to market or have failed NAWAC testing and are not in common circulation. These devices need to be used with caution, and it is advised that consumers contact the supplier and ask if kea protection devices are available or if they are known to be safe around kea following non-target trials. We recommend that traps that do not pass NAWAC are not used in kea habitat until their risks are fully understood. Conclusions on 'Data Poor" trapping devices are therefore best estimates until more information is collected.

6.2 How to use the decision-making table

In order to allow these tables to remain relevant and contemporary they need to be easily updated. Consequently, rather than a standard decision-making tree that terminates in the correct choice based on various parameters, we have represented the table in a colour code so that traps can move up or down the use parameters when we obtain new evidence, proof of non-target testing, or see the development of mitigation options. The colour designation can be interpreted in the following way:

- Green indicates devices, toxins or delivery systems that are safe to use in kea habitat as they are or if adhering to amendments and mitigation techniques.
- Orange represents methods to be used only if necessary and only with narrow parameters to continue to reduce risk to kea.
- Red indicates devices, toxins or delivery systems that should not be used at all in kea habitat as they are known to be a risk to kea health or indeed fatal.

Reporting by the wider trapping community will ensure that this guideline below is contemporary and accurate. Manufacturers and developers are strongly encouraged to engage in formal and consistent non-target testing before bringing any device to the market. Manuals should discuss risk to kea and possible mitigation or clearly outline that the device is not suitable for use in kea occupied habitat.

6.3 Traps

Name	Target Species	Kea deaths or injuries reported	Safe to use
DOC 150/200 Also:BT200	Rat, stoat, ferret	Deaths recorded (at least 24 to date). Kea able to access the traps by removing screws/nails holding down the lid. Also known to interfere with the trap (rolling over, setting off the trap by poking sticks through front opening). Pulling off front mesh. Potential for heavy metal poisoning from ingesting treated timber (data deficient). Metal brackets have been shown to be effective but the most accurate evidence suggests three locking screws with one in the middle of the lid so the wood can't be removed easily around it.	**Safe to use in kea habitat, with the following amendments:** Secure lid with 65mm galvanised steel screws (or ribbed decking nails for the hinge side). The most effective method is to place three attachment points on every lid. The pivot screw/nail a securing screw on the opposite edge (with bracket) and a third screw in the middle of the lid lined up with the internal spacer wall. Three points of contact substantially reduces risks from human error, wear and tear or persistent kea attack. Place metal brackets around side fasteners to prevent kea tearing wood away from around it (and ingesting toxic treated timber). Place solid, stainless steel grills on the ends of trap boxes and using side entrances. Stake the trap boxes with 10mm re-bar (refer appendix for suppliers and photo 5-8).
Victor / D-rat / supervisor / T-Rex traps	Stoat, rat	No known kea deaths.	**Safe to use in kea habitat if set in kea proof cover**
A24	Stoat, rat	Single kea death recorded, kea also recorded on camera inserting their heads in disarmed traps.	**Safe to use in kea habitat if parrot excluder is used** All kills and injuries must be recorded and reported.
Cage trap	Possum, feral cat	High possibility of capturing kea causing captivity related injuries	**Safe to use in kea habitat if monitored closely**

DOC250/ BT250	Rat, stoat, ferret	Die to large entrance there is a high possibility of injury or death of kea which gain access to the trap.	**Do not use in kea habitat** unless absolutely necessary for another threatened species. Use in pulses only when required.
A12	Possum	Single kea death recorded, however there is currently a lack of data. Currently no longer on the market.	**Do not use in kea habitat** unless absolutely necessary for another threatened species. Use in pulses only when required.
Sentinel	Possum, feral cat	Kea death recorded January 2015 in Kepler Mountains.	**Do not use in kea habitat** unless absolutely necessary for another threatened species. Use in pulses only when required.
AT220	Possum, rat, mouse	Kaka deaths have been recorded in AT220 in Dunedin and Wellington, therefore kea are likely to be vulnerable. Day time lock out has been improved but access is very easy for kea and the trigger is non-species specific.	**Do not use in kea habitat** unless absolutely necessary for another threatened species. Use in pulses only when required. Consider exclusion shrouds, select bait carefully and ensure diurnal lock out is operating **with most recent (2021) firmware.**
Trapinator	Possum	Kea deaths reported January 2018. In captive trials, kea have been shown to easily access Trapinators.	**Do not use in kea habitat** unless absolutely necessary for another threatened species. Use in pulses only when required.
Leg hold trap	Possum, feral cat	Kea injury and deaths recorded. Plate is triggered by 500g, and kea weigh 750-1100g.	**Do not use in kea habitat unless the following amendments have been made:** Trigger weight increased to >1.3kg, and ideally solenoid lock to be added to prevent triggering during the day (Morris and Warburton, 2012). **Do not use for possum monitoring in kea habitat**

			(forest and alpine). Utilise alternatives (i.e. wax tags).
PodiTrap	Ferrets	Data poor but kea injury could occur from being struck by the setting bar or if kea enter the device onto the trigger plate.	**If used the following should be observed:** The enclosure would need to be screwed tight and secured to the ground using 10mm re-bar.
SA2 Kat trap/ Belisle Super X 220,	Possum, feral cats	These are open and accessible to kea, the kill mechanism can be triggered by kea and a kea safe enclosure is not viable (i.e. chimney).	**Do not use in kea habitat.** **The use of a chimney tunnel design will not make this suitable in kea habitat.**
Warrior	Possum	Kea deaths recorded.	**Do not use in kea habitat.**
Timms trap	Feral cat	Kea deaths recorded. Easily accessible and attractive to kea. Bait bar easy to manipulate to trigger trap.	**Do not use in kea habitat.**
Flipping timmy	Possum	**Data poor**. Due to their similarity to Timms traps it is logical to conclude that kea are at risk from these devices.	**Do not use in kea habitat.**
Possum Master/Conibear 220&120/KBL Tunnel	Variable feral cat, ferret, possum	None of these traps have passed NAWAC and are not approved for use on DOC administered crown land and should not be used on private land.	**Do not use in kea habitat.** As these are not used, it is not possible to collect risk data and as such they should be avoided.

6.4 Poisons

Name	Target Species	Kea deaths or injuries reported	Safe to use
Feratox	Possum	Interference by kea recorded. No confirmed deaths but likely a high risk to kea as easily accessible.	**Safe to use in kea habitat if using a kea-proof bait station.**

Diphacinone and cholecalciferol (Double Tap)	Possum, rats	Native birds have been shown to have a high tolerance and therefore a low risk of receiving a lethal dose.	**Safe to use in kea habitat if using a kea-proof bait station.**
Cyanide paste	Possum	No reports of kea deaths, however potentially high risk.	**Safe to use in kea habitat if using a kea-proof bait station.**
Brodifacoum	Possum, rodents	Brodifacoum will bioaccumulate in the environment and can have sub-lethal effects on native birds and other non-target species.	**Do not use in kea habitat.**

6.5 Bait delivery stations

Name	Target Species	Kea deaths or injuries reported	Safe to use
Philproof bait station	Rats, mice, possum	Kea deaths recorded.	**Safe to use in kea habitat if using kea baffle.** This precludes their use for possum control.
Rotech © Sentry* metal bait station ex. UK	Rats, mice	Not currently on the market in NZ this strong steal bait box has potential if it can be solidly staked to the ground using 10mm rebar and the lock can be reinforced and tested.	**Safe to use in kea habitat if staked securely on the ground.**
Bait bags stapled to trees	Possum, rats	None recorded however extremely likely. Anecdotal evidence indicates that kea do rip into ferotox bags.	**Do not use in kea habitat.**
KiwiCare Gel stations	Rats, mice	Kea beak marks have been observed in these stations. No kea deaths recorded, as they are likely to die away from the station.	**Do not use in kea habitat.**
Hockey stick / Sentry / Romak / KK / Pied Piper / Rodent Café style plastic bait boxes	Rats, mice	No plastic ground placed bait stations or tree mounted bait buckets are suitable in kea habitat as they are vulnerable to interference leading to kea gaining access to toxin or toxin entering the waterways.	**Do not use in kea habitat.**

**This metal sentry bait station is different to the tree mounted bait bucket used in NZ https://www.1env.com/rotechr-metal-rat-box*

6.6 Images of kea proofing measures

Photo 4: Kea damage around top screw of a typical DOC series trap box, not modified for use in kea habitat. Box lid is no longer secured and kea can access traps.

Photo 5: Galvanised bracket to protect timber around top screw to prevent damage as shown in Photo 4. This should be one of three closure points.

Photo 6: SS mesh to stop kea inserting sticks into trap. Side access only

Photo 7 suggested position of third screw in lid lined up with the top bracket to exclude kea and guard against human error or screw failure.

Photo 8 suggested position of third screw when lid is closed. Hex screws perform better against freezing conditions but users must ensure a tight fit or move it slightly to a new location.

Photo 9: Goodnature Trap A24 with parrot excluder

6.7 Images of kea accessing traps/bait stations

Photo 10: A kea with its head inside a Goodnature A24, with no parrot excluder, 2017

Photo 11: A kea killed in a Fenn trap

7.0 Reporting kea injury/death from pest control activities

Reporting of kea injury or death is essential for informing the wider trapping community of identified risks. As new traps are commercialised, it is important to report incidents so they may be addressed. While emphasis should continue to be placed on safe, non-target testing and exclusion methods prior to traps being made available to the general public, feedback from end users will ensure native fauna safety is paramount at all times. New risks to kea safety could result from a modified methodology or alternative trap application including lure type and placement.

It is acknowledged there may be a reluctance by individuals and groups to come forward to report kea injury or deaths as part of their trapping efforts. However, this reporting is to be commended as it enables risk to be addressed across the country. As such, it is vital to encourage and support reporting and to follow up with provision of support and advice to further reduce any risks to kea. A reporting form for dead kea is available in Appendix 1.

8.0 Emerging technology

The Department of Conservation's Tools to Market funding, along with Predator Free 2050s investment in commercialisation of novel control techniques and devices, has seen a surge in developers becoming heavily involved in advancing pest control options. With a heavy focus on innovative solutions such as artificial intelligence recognition-based triggering, onboard control of toxin release and self-resetting traps, the industry is on the verge of an evolution of pest control practices. However, new developments can create new risks to kea, and unless these new devices are specifically tried and tested to exclude non-targets like kea, weka and kiwi, they should be treated with the utmost of caution. Some devices that are at or nearing commercialisation are outlined below. Possible risk mitigations are explained, and potential risks highlighted were possible.

- **ZIP-Inn** *(Zero Invasive Predators (ZIP)*)– Long run-through trap that is lured inside and outside (hood). When triggered, it closes the entrance doors and floods the internal chamber with CO^2 to euthanize the animal in accordance with laboratory protocol. The trigger is weight sensitive to exclude lighter animals and the entrance is curved specifically to exclude entry by kea, weka and kiwi. A number of mitigation methods are employed to keep kea safe: pegged anchor points prevent devices being rolled down banks; scooped entrance (U-bend) ensures no sticks can be pushed through to the treadle and ensures kea cannot gain access to interact with trigger mechanisms; the hood also has two locking bolts reinforced with metal inserts.

- **LoLa** – "Low Labour" bait station is in development by ZIP. The LoLa tunnel has been designed to be kea-proof and can be securely pegged in place. The tunnel can be used to dispense cereal baits and could be modified to hold a D-block style bait if required. It is also designed to deliver toxin through an auto-lure dispenser. The tunnel has been tested at Willowbank and survived both kea and weka investigations.

- Possum **Spitfire** (*Envico*) – The possum spitfire is a toxin delivery system capable of delivering 80 species-targeted, lethal doses with a longevity of one year. It is currently being field tested in Canterbury. This device is designed to exclude kea through the use of trigger weight thresholds and daytime lock out. The device is also reinforced, and tree mounted to ensure that the toxin remains safely contained inside the device.

- Rat/stoat **Spitfire** (*Envico*) – this is a classic ground-based run through trap which uses and array of sensors to identify small mammals and deliver a lethal dose of toxin. It has a strong box-like structure and can be securely pegged to the ground to ensure the toxin remains safely contained. The entrance is small and restricts access by kea and the two IR trigger sensors are 300mm from the entrance further reducing the likelihood of accidental triggering.

- ***Hammerforce*** possum trap – This is a tree mounted trap with a bite block trigger. When triggered it delivers a fatal impact to the back of the skull. The device then resets and the dead possum falls to the ground. Development testing has included kea exposure trials and a kea excluder collar is being designed.

- ***Hammerforce*** stoat/rat trap – Like its possum specific counterpart this device is also self-resetting and works by delivering a lethal blow to the side of the body using a

pneumatic ram. The dead animal is then jettisoned out the side of the device which subsequently re-arms itself. As a small ground based device it can be securely pegged to the ground and only uses air to recharge the gas canister via a hand held pump.

- ***Cacophony*** High Catch Rate Trap – This device uses a thermal camera to drop curtain like doors and trap anything that moves under the sensor roof. This device has additional modifications if the end user requires them such as an extended low "fence" to funnel animals into the trap location and a selective kill trap which is controlled remotely by an operator. There is currently no AI developed that can differentiate introduced mammals from native birds. Therefore, the potential of injury from accidental capture is high.

- ***Crittersolutions*** **AI triggered trap** (*Crittersolutions*) – This device uses a small camera and on-board algorithm to identify the target species in order to trigger the device. The species identification is passive and does not require a "bite-bar" style interaction in order to fire. This algorithm can therefore completely exclude native birds and other non-target animals. This is completely self-resetting and incorporates an auto-dispensing lure. Field trials will be conducted with non-targets in 2022

- **Norbormide** rat specific toxin (*Connovation*) – Norbormide is a species selective toxicant and has been shown to lead to vasoconstriction and subsequent death in rats only. Mice are not affected nor any native animals or domestic stock/pets. There is no secondary poisoning risk and no bioaccumulation. Consequently, this toxin has huge potential in locations where operators wish to specifically target rats.

9.0 Safety review

An annual review of pest control methods and impact on kea should be undertaken. In addition to this, users of traps should be encouraged to log the type and number of traps / baits used in kea habitat and results (including numbers or absence of kea injuries/deaths per annum/kea interference). Use of a data recording and collation tool such as trap.nz is recommended, so that trap effort, operational area etc can be easily measured.

10.0 The current state of NZ pest control

There is clearly a shortage of kea-safe pest control devices, particularly those targeting possums and cats. Active encouragement of tool development is required, and all reasonable assistance should be given to developers to prioritise testing of new devices. With the recent investment in new technologies for pest control, the commercialisation of many automatically resetting traps and toxin dispensers is approaching. The potential impact these could have on wild kea needs to be tested and assessed thoroughly before these traps reach the market. The risk is that traps get deployed, and we only learn of their devastating impact in real time as successive tragic events occur. Likewise, bait stations that are kea proof are largely absent in Aotearoa, with the exception of a Philproof bucket fitted with an excluder baffle. Since pallet bait

stations are a very useful tool against possums, the fact that the only kea-excluded bait station on the market requires a modification (which also excludes possums) is detrimental to any possum control objectives. Likewise, there is currently no commercially available ground bait station that could be considered kea safe. These should be sourced from overseas or be highlighted as an industry necessity to the various device developers in New Zealand.

This document identifies problems with a number of traps used as ground-based pest control tools, leaving a restricted number of options in kea habitat. This may appear to contradict the acceptance by the Kea Conservation Trust and the Department of Conservation of ongoing aerial 1080 use in kea habitat. Aerial 1080 is still used due to the benefits, which have been measured in detail and demonstrably outweigh the costs. An advantage of aerial 1080 over ground-based tools is that it is ephemeral in the environment, so there is a relatively short period where kea may encounter toxic baits. Ground-based devices, conversely, may be present for months, or even year-round, giving more time to inflict costs to the kea population. It is also very rare that ground-based tools are used on a sufficiently large scale as to allow quantification of predator control benefits to kea.

Organisations involved in large-scale deployments (>5,000 ha) of ground-based predator control methods are encouraged to engage in research on risk to kea.

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Appendix 1 - Reporting form for dead kea

Please complete all details (one form for each kea) and email to info@keaconservation.co.nz
Where predator control tools are a known or suspected cause of death, please also forward to non-target@doc.govt.nz

Date of death (where possible) **or recovery of body**	*(day/month/year)*
Location description	*(e.g. found in carpark, on side of road, in creek, caught in trap etc)*
Location area	*(e.g. Fox Glacier)*
Region	*(e.g. West Coast)*
Probable cause of death	
Post-mortem report available? *(attach if Yes)*	
Description of state of carcass	*(any obvious breaks, is bird wet, presence of blood, faeces etc)*
Band details of recovered kea (if any)	
Transmitter details (if any)	
Who recovered body?	*(member of the public, DOC staff member etc (name and contact details for follow up)*
Where is body stored?	
Contact details of person entering information into this form	*(name, email, organisation)*
Unique identifier (post mortem band number)	*(office use only)*

Appendix 2 - Contacts

Name	Contact details	Affiliation	Location	Expertise
Tamsin Orr-Walker	info@keaconservation.co.nz	KCT	Queenstown	General info on this document and Strategic Plan
Josh Kemp	jkemp@doc.govt.nz	DOC	Nelson	Pest control, kea
Chris Birmingham	cbirmingham@doc.govt.nz 03 249 0200	DOC	Te Anau	
Peter McMurtrie	pmcmurtrie@doc.govt.nz 03 249 0200	DOC	Te Anau	Kea proofing DOC 150/200's Fiordland Islands
Andrew Smart	asmart@doc.govt.nz 03 249 0200	DOC	Te Anau	Kea proofing DOC 150/200 Northern Fiordland

Appendix 3 - Pest control suppliers

Name	Contact details	Device	Specifics
Fielden Metalworks	23 Columbia Ave, PO Box 16450, Hornby, ChCh. Ph. 03 3490000	DOC 200 (stoat box)	Suppliers of stainless-steel grills for DOC 150 and 200 traps
Wood Logic	Cnr Caswell Road & Snodgrass Drive, Te Anau Ph: 03 249 7868. billanddaphne@xtra.co.nz	DOC 200 (stoat box)	Make traps with the stainless ends and side entrances.
Haines Pallets	111 Hutt Park Rd, Seaview, Wellington. Ph. 04 568 6898. haines.pallets@xtra.co.nz	DOC 200 (stoat box)	Make traps with the stainless ends and side entrances.
Goodnature Traps	8 Horner Street, Newtown, Wellington 6021. Ph. 04 389 1025. hello@goodnature.co.nz	A12 and A24	Supply parrot excluders for resetting traps.